Site Need Statement

General Reference Information	
1 *	***Need Title:*** Extension of Glass Properties Model to LAW and Phase II HLW Glass Composition Ranges
2 *	***Need Code:*** RL-WT084
3 *	***Need Summary:*** The glass properties model, developed by PNNL to describe the liquidus temperature, viscosity, and durability of glasses as a function of their compositions, should be extended to include projected LAW compositions and lower silica compositions recently projected for HLW.
4 *	***Origination Date:*** FY 2000 (2/25/00)
5 *	***Need Type:*** Technology Need
6	***Operation Office:*** Office of River Protection (ORP)
7	***Geographic Site Name:*** Hanford Site
8 *	***Project:*** Office of River Protection - Treat Waste Balance of Mission ***PBS No.:*** ORP-TW07
9 *	***National Priority:*** ____1. High - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. _X_2. Medium - Provides substantial benefit to EM program projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). ____3. Low - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	***Operations Office Priority:***
Problem Description Information	
11	***Operations Office Program Description:*** Double Shell Tank (DST) and Waste Feed Delivery project maintains, operates and upgrades the DST System for continued safe storage and receipt of radioactive waste. Activities include transferring waste to waste treatment facilities, maintaining and evaluating operating and surveillance systems necessary for compliance with regulatory and AA/AB requirements, identifying if systems are reliable for this mission, transferring waste within the DSTs to manage the limited available space; characterizing waste to understand its properties, and developing flow sheets for waste treatment.
12	***Need/Problem Description:*** The "Glass Properties Models" (GPM) were developed by PNNL to model certain properties of waste glasses as functions of their compositions. These models and knowledge of the glass properties, such as liquidus temperature, viscosity, and durability, may be used to determine the amounts of waste that can be practically incorporated into the glass and to provide estimates of the volume of the final immobilized waste form. These estimates are critical to successful processing of Hanford's high-level wastes into acceptable vitrified waste forms, since they are used to predict the waste feed rates and total amounts of feed required to meet the terms of the vitrification contract. Currently, the GPM supports predictions for glass compositions ranging consistent with previous flowsheet assumptions for the Hanford Waste Vitrification Plant (HWVP). However, recent developments in the HLW vitrification program and addition of the LAW vitrification have changed the composition region in which Hanford will produce glass. Examples of the differences in composition include a reduction of SiO2 and increase in SrO and MnO. Comparisons have shown that current GPM-based predictions of glass properties in some of this new composition space are inaccurate. This difference could potentially lead to large differences prediction of glass volumes, feed requirements, and melter sizing. Lack of an accurate model also jeopardizes the ability of the Waste Feed Delivery Project to accurately predict the amounts of waste that are required to meet production goals. The effect of these proposed glass formulation changes on the GPM predictions is not known. GPM must be updated to cover the new expected composition regions for both HLW and LAW glasses for those properties that may limit the loading of waste in glass, including troublesome component solubilities.

	liquidus temperature, viscosity, and product consistency test. Additional data must be obtained to improve the accuracy of these GPMs and to validate them within the expected glass composition regions. Expanded glass models may also be applicable to increasing waste oxide loading at the Defense Waste Processing Facility (Savannah River) and at the Idaho National Environmental and Engineering Laboratory (Idaho Falls).
13	***Functional Performance Requirements:*** Models capable of predicating key properties of Hanford LAW and HLW glasses will be developed. Those properties found to be most responsible for waste loading limitation in Hanford LAW and HLW glasses will be the primary focus, including: liquidus temperature and solubility's of troublesome components. The composition regions over which these models are to be developed will include those expected from vitrification of all waste from Hanford underground storage tanks. Differences between the composition regions covered by existing data, those expected from Hanford LAW and HLW glasses will be identified, and test matrices will be developed to cover these composition regions. Priority will be given to those properties and compositions applicable to most of the Hanford waste. When completed, the models will be capable of estimating waste loading as a function of waste composition and will help in glass formulation development and complete flowsheet optimization (including retrieval, pretreatment, and blending). **Schedule Requirements:** 0-3 yr. The near-term need for this information is to improve the reliability of the Waste Treatment Plant design and plans for delivery of waste feed to the Waste Treatment Plant. Needs for this type of data will remain well into the life of the project (>20 yr.) as program requirements change and opportunities for cost savings arise.
14	***Definition of Solution:***
15 *	***Targeted Focus Area:*** Tanks Focus Area (TFA)
16	***Potential Benefits:*** Removing uncertainty of glass volume prediction will improve the ability to deliver wastes efficiently and on time. Development of glasses with higher waste loadings would produce large cost savings.
17 *	***Potential Cost Savings:*** $250,000,000
18 *	***Potential Cost Savings Narrative:*** Reduced conservatism in HLW/ILAW performance assessment and disposal system design.
	Technical Basis: Although the GPM can be extrapolated to cover the low-silica glasses, there is no data in the GPM in that range. Current indications are that the GPM correlations are highly curved in this region, leading to substantial errors.
19	***Cultural/Stakeholder Basis:*** Long-term disposal of the high-level wastes stored in Hanford's underground tanks is a national priority. The DOE has a legal agreement (the Tri-Party Agreement) with the Environmental Protection Agency and the State of Washington Department of Ecology to dispose of the waste according to a stated schedule. Native American tribal interests and a number of public interest groups monitor adherence to this agreement. Program delays due to inability to retrieve and deliver sufficient waste feed to the WTP may result in violations of the Tri-Party Agreement.
20	***Environment, Safety, and Health Basis:*** Program delays provide more time for the waste storage tanks to fail. It is important to maintain programmatic schedule to avoid increased risks of soil contamination from tank leakage.
21	***Regulatory Drivers:*** Tri-Party Agreement (TPA)
22 *	***Milestones:*** Supports technical basis of TPA milestone M-45-02 "Submit annual updates to SST retrieval sequence document," 9/30/2000 and annually thereafter.
23 *	***Material Streams:*** ID-3857 HLW to Treatment and LAW
24 *	***TSD System:*** Hanford 200 Area underground storage tanks ("tank farms") DSTs and SSTs
25	***Major Contaminants:*** Fission products, actinides, nitrate

26	***Contaminated Media:*** N/A. This project addresses wastes in engineered containment.
27	***Volume/Size of Contaminated Media:*** 204,400 m^3. See R. A. Kirkbride, "Tank Farm Contractor Operation and Utilization Plan," HNF-SD-WM-SP-012, Rev. 2, p. "Summary-3," (CH2M HILL Hanford Group, Inc., Richland, WA, April 19, 2000). For details, see, e.g., B. M. Hanlon, "Waste Tank Summary Report for Month Ending June 30, 2000," HNF-EP-0182-147, (CH2M HILL Hanford Group, Inc., Richland, WA, August 2000).
28 *	***Earliest Date Required:*** 03/20/2000
29	***Latest Date Required:*** 2020
Baseline Technology Information	
30	***Baseline Technology/Process:*** The GPM provides the baseline technology for prediction of glass waste volume. **Technology Insertion Point(s):** N/A
31	***Life-Cycle Cost Using Baseline:*** Costs are included in Activity 150.B22, "Maintain the Operations & Utilization Plan." Life Cycle Costs related to glass volume production are best represented by the differential cost related to reduced number of waste packages produced. For example, costs of equipment, operations, maintenance and infrastructure upgrades over time, will be incurred whether the facilities produce one canister of glass or 1,000. Using this premise, a 20% reduction in number of HLW canisters can result in savings of about $1-2 Billion in repository fees on production costs of $4-8 Billion.
32	***Uncertainty on Baseline Life-Cycle Cost:*** Unknown
33	***Completion Date Using Baseline:*** Maintenance of the Operations & Utilization Plant continues through the life of the project. The RPP is scheduled to complete in year 2030.
Points of Contact (POC)	
34	***Contractor End User POCs:***
35	***DOE End User POCs:*** R.(Rudy) Carreon, DOE-ORP, 509-373-7771, F/509-373-0628, Rodolfo_Rudy_Carreon@rl.gov E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov B.M. (Billie) Mauss, DOE-ORP, 509-373-5113, F/509-372-2781, Billie_M_Mauss@rl.gov
36 *	***Other Contacts:*** S.A. (Steve) Wiegman, DOE-ORP, 509-372-2536, F/509-372-2781, Stephen_A_Wiegman@rl.gov M.E. (Michael) Johnson, CH2M HILL Hanford Group, Inc., 509-372-3628, F/509-376-1788, Michael_E_Johnson@rl.gov

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